

We Claim:

1. A composition comprising a transesterified fatty acid ester, a fatty acid ester with a carbon number of eight to twenty-two being transesterified through reaction with a compound containing a hydroxyl functional group in the presence of an acid.
2. A composition comprising reaction products from a reaction of a fatty acid ester with a carbon number of eight to eighteen with a compound containing a hydroxyl functional group in the presence of an acid, the reaction products including a transesterified fatty acid ester.
3. The composition of claims 1 or 2 wherein the fatty acid ester is a vegetable oil.
4. The composition of claim 3 wherein the vegetable oil is castor oil.
5. The composition of claim 4 wherein the castor oil contains at least about 80 percent ricinoleic acid.
6. The composition of claim 1 or 2 wherein the fatty acid ester is selected from the group consisting of ricinoleic acid, oleic acid, linoleic acid, stearic acid, lauric acid, myristic acid and palmitic acid.
7. The composition of 1 or 2 wherein the fatty acid ester has a carbon number of 18.
8. The composition of claim 7 wherein the fatty acid ester is ricinoleic acid.
9. The composition of claim 8 wherein the transesterified fatty acid ester includes ricinoleic n-propyl ester.

10. The composition of claim 8 wherein the reaction produces an ester of ricinoleic acid and glycerol.
11. The composition of claim 8 wherein the reaction produces a phosphated fatty acid ester.
12. The composition of claim 8 wherein the reaction produces glycerol ricinoleate and n-propyl ricinoleate.
13. The composition of claim 1 or 2 wherein the fatty acid ester is dimerized or trimerized.
14. The composition of claim 1 or 2 wherein the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid and phenol sulfonic acid.
15. The composition of claim 1 or 2 wherein the acid contains phosphorus.
16. The composition of claim 1 or 2 wherein the acid is phosphoric acid.
17. The composition of claim 1 or 2 wherein the acid contains sulfur.
18. The composition of claim 1 or 2 wherein the acid is sulfuric acid.
19. The composition of claim 1 or 2 wherein the acid contains a functional group selected from the group consisting of a phosphate and a sulfate functional group.
20. The composition of claim 19 wherein the composition includes a functional group selected from the group consisting of a phosphate ester functional group and a sulfate ester functional group.

21. The composition of claim 19 wherein the composition includes a functional group selected from the group consisting of a phosphorus-containing ester functional group and a sulfur-containing ester functional group.
22. The composition of claim 19 wherein the composition includes a functionality selected from the group consisting of a phosphorous-containing functionality and a sulfur-containing functionality.
23. The composition of claim 1 or 2 wherein the compound containing the hydroxyl functional group is an alcohol having a carbon number from C1 to C18.
24. The composition of claim 23 wherein the alcohol is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.
25. The composition of claim 1 or 2 wherein the compound containing the hydroxyl functional group is n-propyl alcohol.
26. The composition of claim 1 or 2 wherein
the fatty acid ester is a vegetable oil; and
the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.
27. The composition of claim 1 or 2 wherein
the fatty acid ester is a vegetable oil; and

the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.

28. The composition of claim 1 or 2 wherein

the fatty acid ester is a vegetable oil;

the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols; and the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.

29. The composition of claim 1 or 2 wherein

the fatty acid ester has a carbon number of 18; and

the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.

30. The composition of claim 1 or 2 wherein

the fatty acid ester has a carbon number of 18, and

the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.

31. The composition of claim 1 or 2 wherein
the fatty acid ester has a carbon number of 18;
the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols; and
the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.
32. The composition of claim 1 or 2 wherein at least a portion of the composition includes an estolide functional group.
33. The composition of claim 1 or 2 further comprising a miscibility-enhancement additive effective to increase miscibility with naphthenes, paraffins, alkyl benzenes, mineral oils, polyol esters, polyalphaolefins, polyalkylene glycols, polybutenes, polyvinyl ethers and substituted hydrocarbons.
34. The composition of claim 33 wherein the miscibility-enhancement additive is selected from the group comprising C10 to C18 long chain alcohols, esters, quaternary ammonium salts and alkyl benzenes.
35. The composition of claim 33 wherein the effective amount of the miscibility-enhancement additive is from about 0.1 percent to about 10 percent by weight of the composition.
36. The composition of claim 33 wherein the effective amount of the miscibility-enhancement additive is from about 1 percent to about 5 percent by weight of the composition.

37. The composition of claim 1 or 2 further comprising reacting the transesterified fatty acid ester with a second compound having an acetyl, alkyl oxy, alkyl propoxy or carboxyl functional group to form a further-substituted fatty acid ester that includes an acetyl, alkyl oxy, alkyl propoxy or ester functional group.
38. A composition resulting from the mixture of reactants, the reactants comprising:
- 25 mol %-36 mol % of fatty acid ester;
58 mol% - 62 mol% of alcohol; and
8-10 mol % acid.
39. The composition of claim 38 wherein the fatty acid ester is vegetable oil.
40. The composition of claim 39 wherein the vegetable oil is castor oil.
41. The composition of claim 38 wherein the fatty acid ester is selected from the group consisting of ricinoleic acid, oleic acid, stearic acid, lauric acid, myristic acid and palmitic acid.
42. The composition of claim 38 wherein the fatty acid ester is ricinoleic acid.
43. The composition of claim 38 wherein the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.
44. The composition of claim 38 wherein the acid is phosphoric acid.
45. The composition of claim 38 wherein the acid is sulfuric acid.

46. The composition of claim 38 wherein the compound containing the hydroxyl functional group is an alcohol having a carbon number from C1 to C18.
47. The composition of claim 38 wherein the alcohol is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.
48. The composition of claim 38 wherein the compound containing the hydroxyl functional group is n-propyl alcohol.
49. The composition of claim 38 wherein
the fatty acid ester is castor oil; and
the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.
50. The composition of claim 38 wherein
the fatty acid ester is castor oil; and
the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.
51. The composition of claim 38 wherein
the fatty acid ester is castor oil;
the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl

alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols; and the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.

52. The composition of claim 38 wherein
the fatty acid ester has a carbon number of 18; and
the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.
53. The composition of claim 38 wherein
the fatty acid ester has a carbon number of 18, and
the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.
54. The composition of claim 38 wherein
the fatty acid ester has a carbon number of 18;
the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols; and
the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids,

sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.

55. A compound having the formula:



wherein

Ac is an acid functional group

x + y gives a resultant from 10 to 20; and

z is from 1 to 2

56. The compound of claim 55 wherein Ac is H₂PO₃.

57. The compound of claim 55 wherein Ac is H₂SO₄.

58. A process for lubrication of a lubricant-dependant system with a fluid comprising adding an effective amount of a transesterified fatty acid ester to the lubricant-dependant system in the fluid, the transesterified fatty acid ester resulting from the reaction of a fatty acid ester having a carbon number between eight and twenty-two with a compound containing a hydroxyl functional group in the presence of an acid.

59. A process for increasing heat transfer in a heat transfer system capable of receiving a heat transfer fluid comprising adding an effective amount of a transesterified fatty acid ester to the heat transfer fluid, the transesterified fatty acid ester resulting from the reaction of a fatty acid ester having a carbon number between eight and twenty-two with a compound containing a hydroxyl functional group in the presence of an acid.

60. A process for modification of rheological properties of a hydro-mechanical fluid comprising adding an effective amount of a transesterified fatty acid ester to the hydro-mechanical fluid, the transesterified fatty acid ester resulting from the reaction of a fatty acid ester having a carbon number between eight and twenty-two with a compound containing a hydroxyl functional group in the presence of an acid.
61. A process for inhibition of corrosion for a corrosion-susceptible mechanical system comprising contacting the corrosion-susceptible mechanical system with a fluid having an effective amount of a transesterified fatty acid ester, the transesterified fatty acid ester resulting from the reaction of a fatty acid ester having a carbon number between eight and twenty-two with a compound containing a hydroxyl functional group in the presence of an acid.
62. A process for inhibition of moisture for a moisture-susceptible mechanical system comprising contacting the moisture-susceptible mechanical system with a fluid having an effective amount of a transesterified fatty acid ester, the transesterified fatty acid ester resulting from the reaction of a fatty acid ester having a carbon number between twelve and twenty-two with a compound containing a hydroxyl functional group in the presence of an acid.
63. The process of claim 58, 59, 60, 61 or 62 wherein the effective amount of the transesterified fatty acid ester is from about 0.5 percent to 100 percent by volume of the fluid.
64. The process of claim 63 wherein the effective amount of the transesterified fatty acid ester is from at least about 5 percent to about 20 percent by volume of the fluid.
65. The process of claims 58, 59, 60, 61 or 62 wherein the fatty acid ester is a vegetable oil.
66. The process of 65 wherein the vegetable oil is castor oil.

67. The process of claim 58, 59, 60, 61 or 62 wherein the fatty acid ester is selected from the group consisting of ricinoleic acid, oleic acid, stearic acid, lauric acid, myristic acid and palmitic acid.
68. The process of 58, 59, 60, 61 or 62 wherein the fatty acid ester has a carbon number of 18.
69. The process of claim 68 wherein the fatty acid ester is ricinoleic acid.
70. The process of claim 69 wherein the transesterified fatty acid ester includes ricinoleic propanol ester.
71. The process of claim 69 wherein the reaction produces a glycerol ester.
72. The process of claim 69 wherein the reaction produces a phosphated fatty acid ester.
73. The process of claim 69 wherein the reaction produces glycerol ricinoleate and n-propyl ricinoleate.
74. The process of claim 58, 59, 60, 61 or 62 wherein the fatty acid ester is dimerized or trimerized.
75. The process of claim 58, 59, 60, 61 or 62 wherein the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.
76. The process of claim 58, 59, 60, 61 or 62 wherein the acid contains phosphorus.
77. The process of claim 58, 59, 60, 61 or 62 wherein the acid is phosphoric acid.

78. The process of claim 58, 59, 60, 61 or 62 wherein the acid contains sulfur.
79. The process of claim 58, 59, 60, 61 or 62 wherein the acid is sulfuric acid.
80. The process of claim 58, 59, 60, 61 or 62 wherein the acid contains a functional group selected from the group consisting of a phosphate and a sulfate functional group.
81. The process of claim 80 wherein the composition includes a functional group selected from the group consisting of a phosphate ester functional group and a sulfate ester functional group.
82. The process of claim 81 wherein the composition includes a functional group selected from the group consisting of a phosphorus-containing ester functional group and a sulfur-containing ester functional group.
83. The process of claim 82 wherein the composition includes a functionality selected from the group consisting of a phosphorous-containing functionality and a sulfur-containing functionality.
84. The process of claim 58, 59, 60, 61 or 62 wherein the compound containing the hydroxyl functional group is an alcohol having a carbon number from C1 to C18.
85. The process of claim 84 wherein the alcohol is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.
86. The process of claim 58, 59, 60, 61 or 62 wherein the compound containing the hydroxyl functional group is n-propyl alcohol.

alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols.

91. The process of claim 58, 59, 60, 61 or 62 wherein the fatty acid ester has a carbon number of 18, and the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.
92. The process of claim 58, 59, 60, 61 or 62 wherein the fatty acid ester has a carbon number of 18; the compound containing a hydroxyl functional group is selected from the group consisting essentially of methyl alcohol, ethyl alcohol, butyl alcohol, pentyl alcohol, hexyl alcohol, heptyl alcohol, octyl alcohol, nonyl alcohol, decyl alcohol, dodecanol, iso-propyl alcohol, n-propyl alcohol, glycerol, substituted alcohols and multiple hydroxy functional group alcohols; and the acid is selected from phosphoric acid, muriatic acid, nitric acid, phosphonic acid, phosphorus acid, chloro sulfonic acid, dodecylbenzene sulfonic acid, organic sulfonic acids, sulfuric acid, acetic acid, sulfosalicylic acid, aromatic sulfonic acids, sulfamic acid, gluconic acid, citric acid, formic acid, hydroxy acetic acid and hydroxy benzoic acids.
93. The process of claim 58, 59, 60, 61 or 62 wherein at least a portion of the composition includes a estolide functional group.
94. The process of claim 58, 59, 60, 61 or 62 further comprising a miscibility-enhancement additive effective to increase miscibility with naphthenes, paraffins, alkyl benzenes, mineral oils, polyol esters, polyalphaolefins, polyalkylene glycols, polybutenes, polyvinyl ethers and substituted hydrocarbons.

95. The process of claim 94 wherein the miscibility-enhancement additive is selected from the group comprising C10 to C18 long chain alcohols, esters, quaternary ammonium salts and alkyl benzenes.
96. The process of claim 94 wherein the effective amount of the miscibility-enhancement additive is from at least about 0.1 percent to about 10 percent by weight of the composition.
97. The process of claim 94 wherein the effective amount of the miscibility-enhancement additive is from at least about 1 percent to about 5 percent by weight of the composition.
98. The process of claim 58, 59, 60, 61 or 62 further comprising reacting the transesterified fatty acid ester with a second compound having an acetyl, alkyl oxy, alkyl propoxy or carboxyl functional group to form a further-substituted fatty acid ester that includes an acetyl, alkyl oxy, alkyl propoxy or ester functional group.
99. The process of claim 58 wherein the lubricant-dependant system is selected from the group comprising a mechanical device, a refrigeration system, a motor oil system, an engine, an engine part, a gear, a drilling operation and a reciprocating combustion engine.
100. The process of claim 58 wherein the composition is capable of providing lubrication at temperatures up to about 350 degrees C.
101. The process of claim 58 wherein the composition lubricant is capable of providing lubrication below 0 degrees C.
102. The process of claim 59 wherein the heat transfer system is selected from the group comprising a coolant system, a hydraulic braking system, a hydraulic transmission system, a refrigeration system and an air-conditioning system.

103. The process of claim 60 wherein the hydro-mechanical fluids are functional fluids.
104. The process of claim 60 wherein the hydro-mechanical fluids are selected from the group consisting of radiator fluid, drilling fluid, engine fluid, anti-corrosive fluid, transmission fluid, hydraulic fluid, brake fluid, dielectric fluid, heat transfer fluid and cutting fluid.
105. The process of claim 61 or 62 wherein the mechanical system is a reciprocating combustion engine, a hydraulic braking system, a hydraulic transmission system or a coolant system.
106. A substance effective in providing lubrication to a mechanical system comprising a transesterified fatty acid ester, a fatty acid ester with a carbon number of eight to twenty-two being transesterified through reaction with a compound containing a hydroxyl functional group in the presence of an acid, the transesterified fatty acid ester having an HLB between about 0.5 and 4.8 and exhibiting in excess of 1000 pounds force load to failure.
107. The substance of claim 106 wherein the fatty acid ester is ricinoleic acid.
108. The substance of claim 107 wherein the compound containing a hydroxyl functional group is n-propyl alcohol.
109. The substance of claim 107 wherein the acid is phosphoric acid.
110. A process for cleaning mechanical system comprising contacting the mechanical system with a fluid having an effective amount of a transesterified fatty acid ester, the transesterified fatty acid ester resulting from the reaction of a fatty acid ester having a carbon number between eight and twenty-two with a compound containing a hydroxyl functional group in the presence of an acid.
111. The transesterified fatty acid ester of claim 110 wherein the fatty acid ester is ricinoleic acid.

112. The transesterified fatty acid ester of claim 111 wherein the compound containing a hydroxyl functional group is n-propyl alcohol.
113. The transesterified fatty acid ester of claim 111 wherein the acid is phosphoric acid.